



Multiwindow support on Android

Andrzej Wieczorek

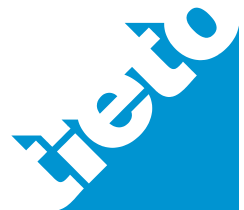
Mikel Echegoyen

Tieto Product Development Services



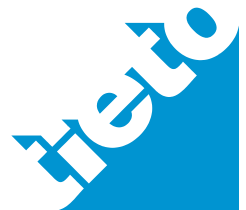
About us...

- Andrzej Wieczorek
 - Business Development Manager
 - responsible for Android product creation and connectivity areas for mobile and embedded devices
- Mikel Echegoyen (@echegmik)
 - Business Development Director, Semiconductors
 - 14 years in Mobile R&D on multiple roles from development to sales
- Tieto Product Development Services
 - R&D in communications and embedded technologies
 - Part of Tieto, 14000 employees, headquarters in Finland
 - More at www.tieto.com/pds



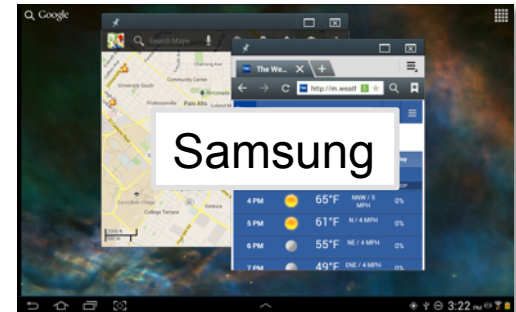


**60 second demo
=
a thousand words**





Déjà Vu, Much?



and more...





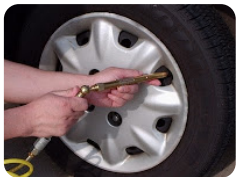
Don't reinvent the wheel...

rather inflate & add more!

Cornerstone
ICS (4.0/4.1)



"It's dead, Jim"



"came back to life!"

Cornerstone
Port to 4.2.2



"Running on latest"

Add float mode,
Settings, features



"Racing ready"

Re-architect for
KitKat 4.4



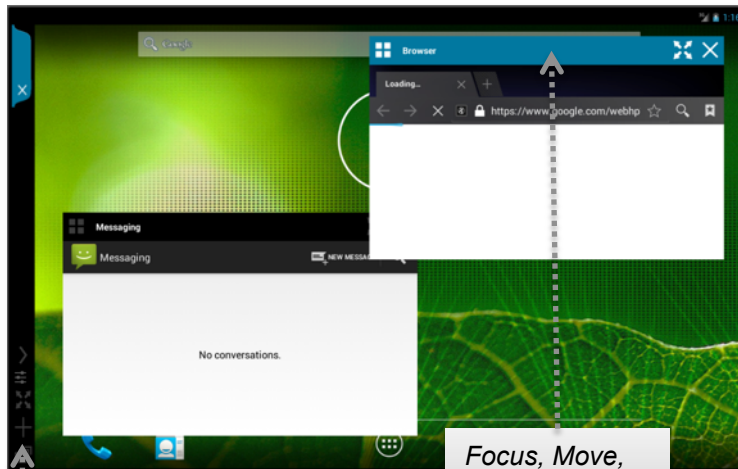
"Get new tires!"





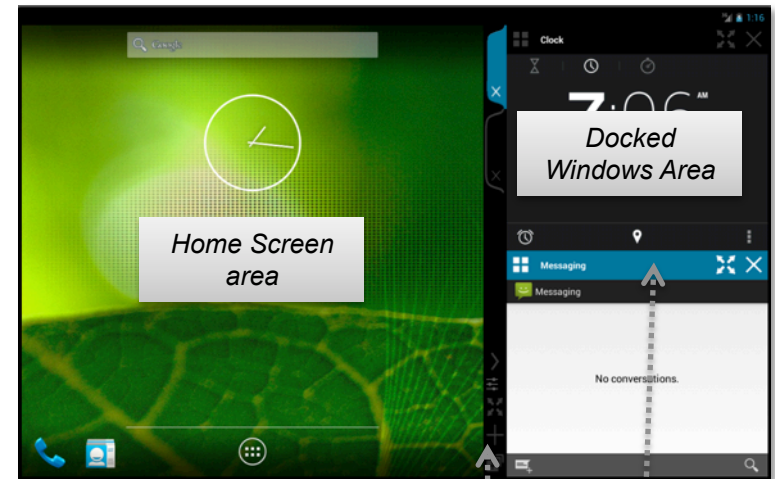
Multiwindow feature overview

Floating windows



*Focus, Move,
Resize, Close
Window*

Docked windows



*Move window
to Home
Screen area,
Close*

Windows Manager application

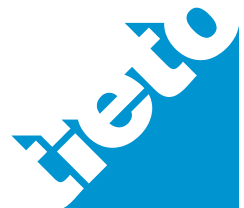
- Show/hide/edit windows (e.g. resize)
- Move Window Manager (left, right)
- Toggle floating/docked windows UX
- Add new Window
- Add new tab (group windows)





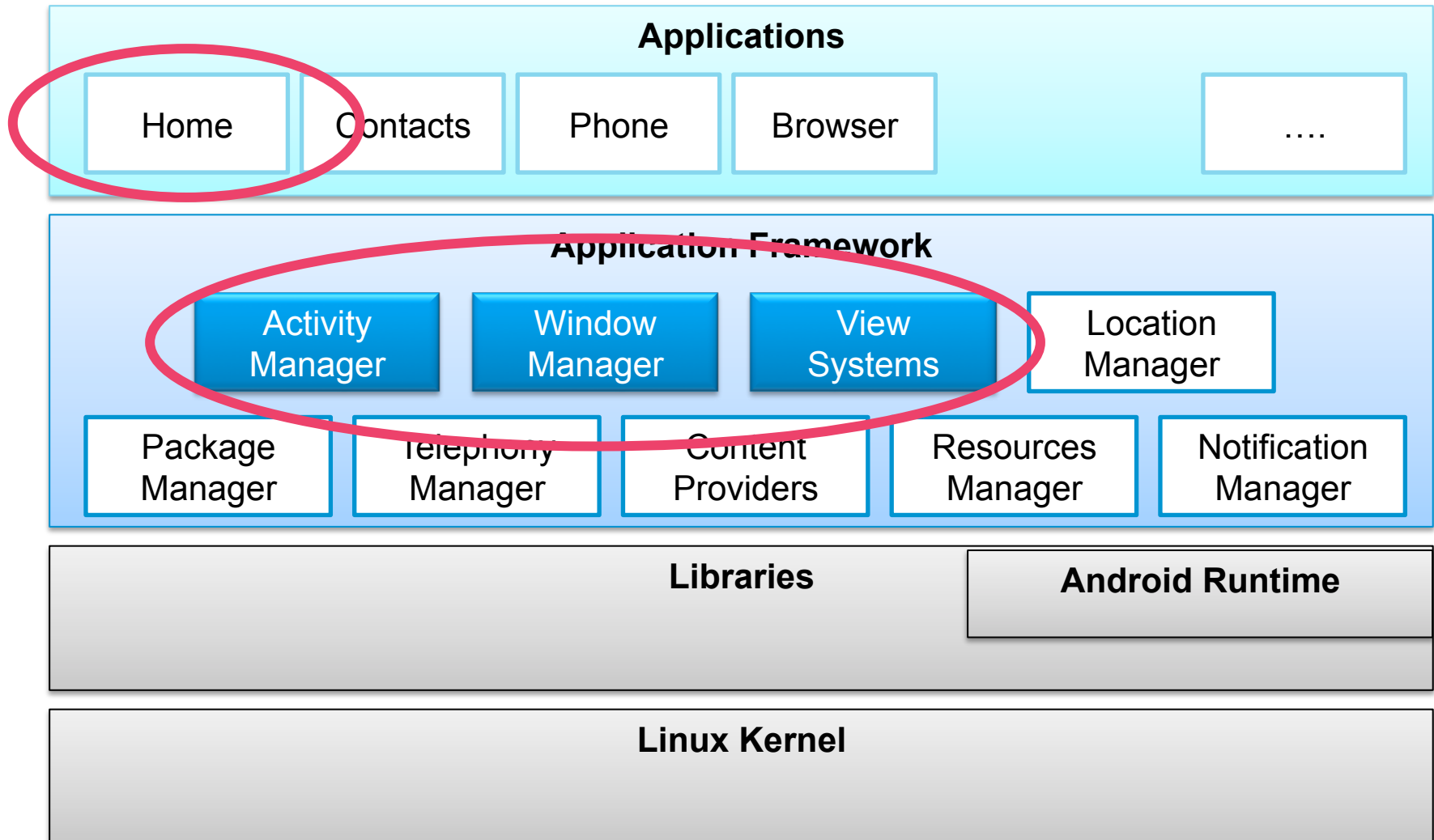
Feature comparison

Feature	Tieto MW	Cornerst.	Rockchip	Ixonos	Samsung	Sony
Basic features: open, close, move, resize, maximize, etc.	✓	✓	✓	✓	✓	✓
Advanced features: group windows, swap	✓	✗	✗	✓	✗	✗
Docked windows UX	✓	✓	✓	✗ Super window	✓	✗
Floating windows UX	✓	✗	✓	✓	✗	✓
MultilInstance for Apps	✗	✗	✗	✗	✓ dedicated	✗
CTS	✗ Coming soon	✗	?	?	✓	✓
OpenSource	✓	✓	✗	✗	✗	✗
Transparent for apps	✓	✓	✓	?	✗Flag req.	✗
Android Version	4.2.2, 4.4	4.0, 4.1, 4,3	4.2.2	4.2.2	4.2+	4.0+



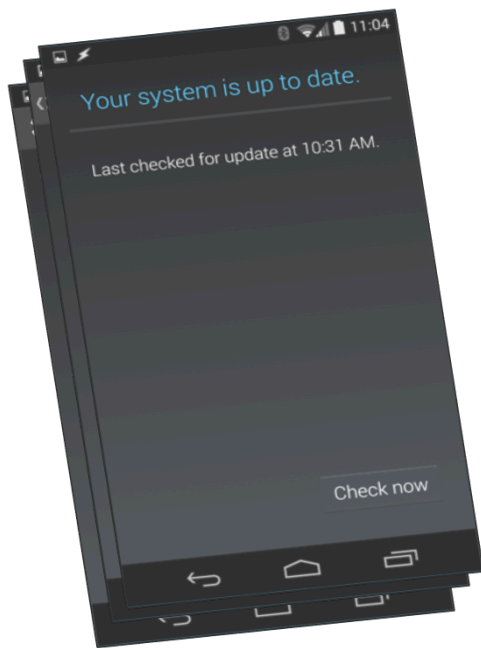


Architecture changes for multiwindow

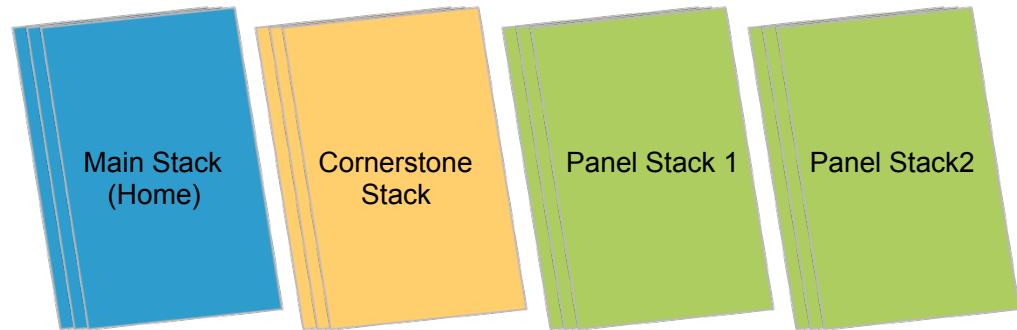




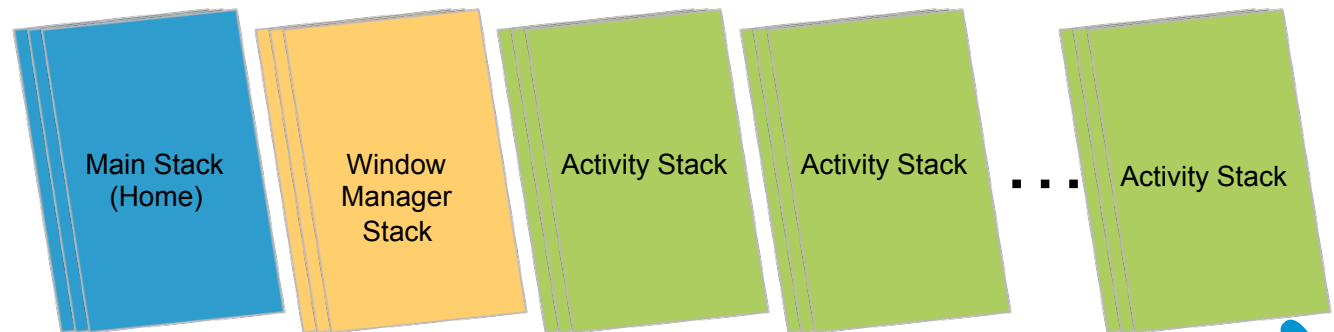
Multiple Activity stacks



Activity stack



Cornerstone

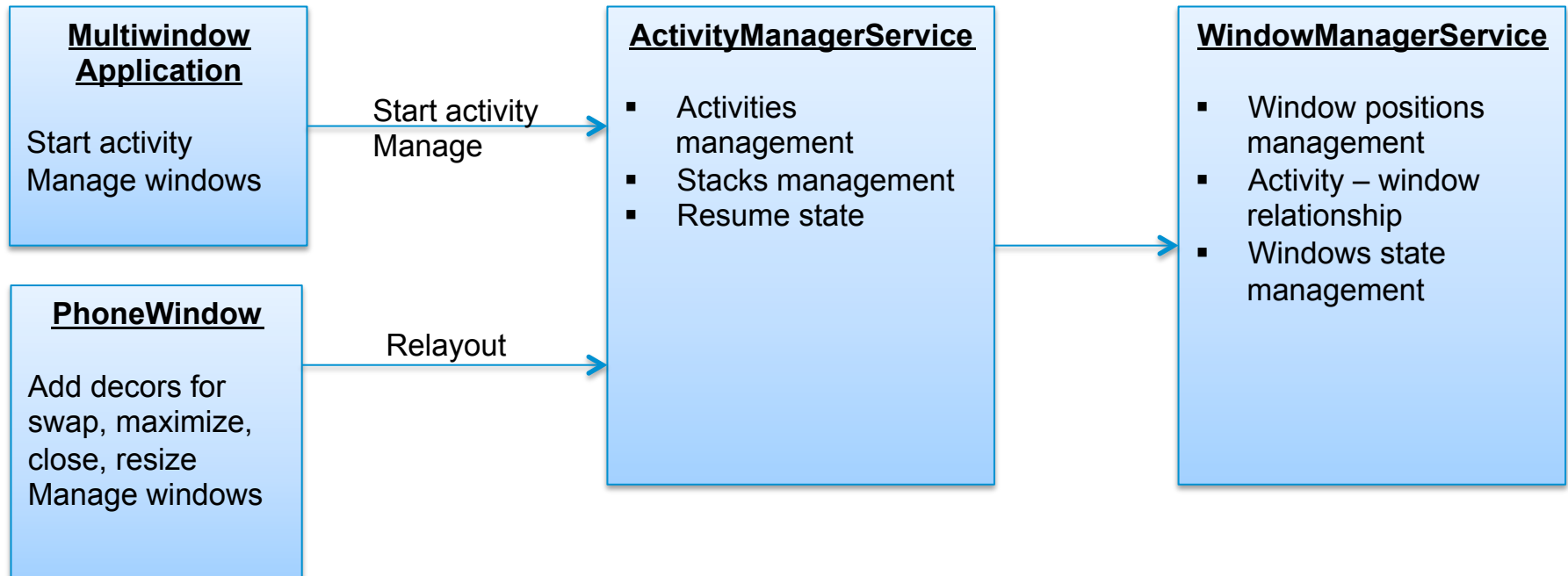


Tieto





How it works

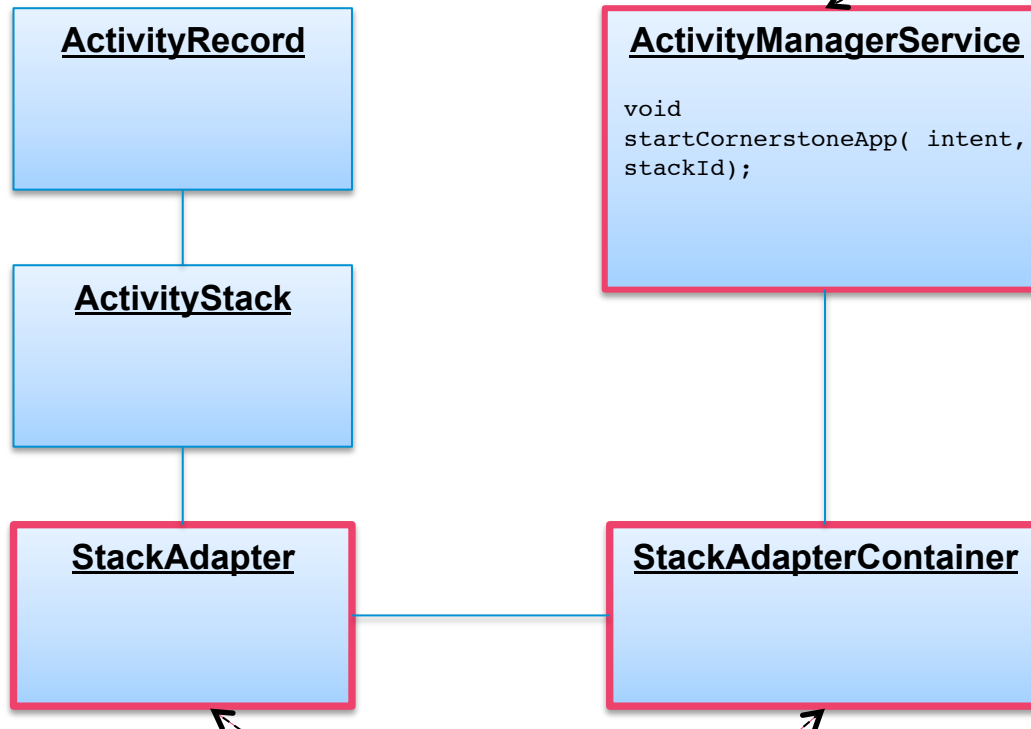


ActivityManagerService changes

Jelly Bean (4.2)



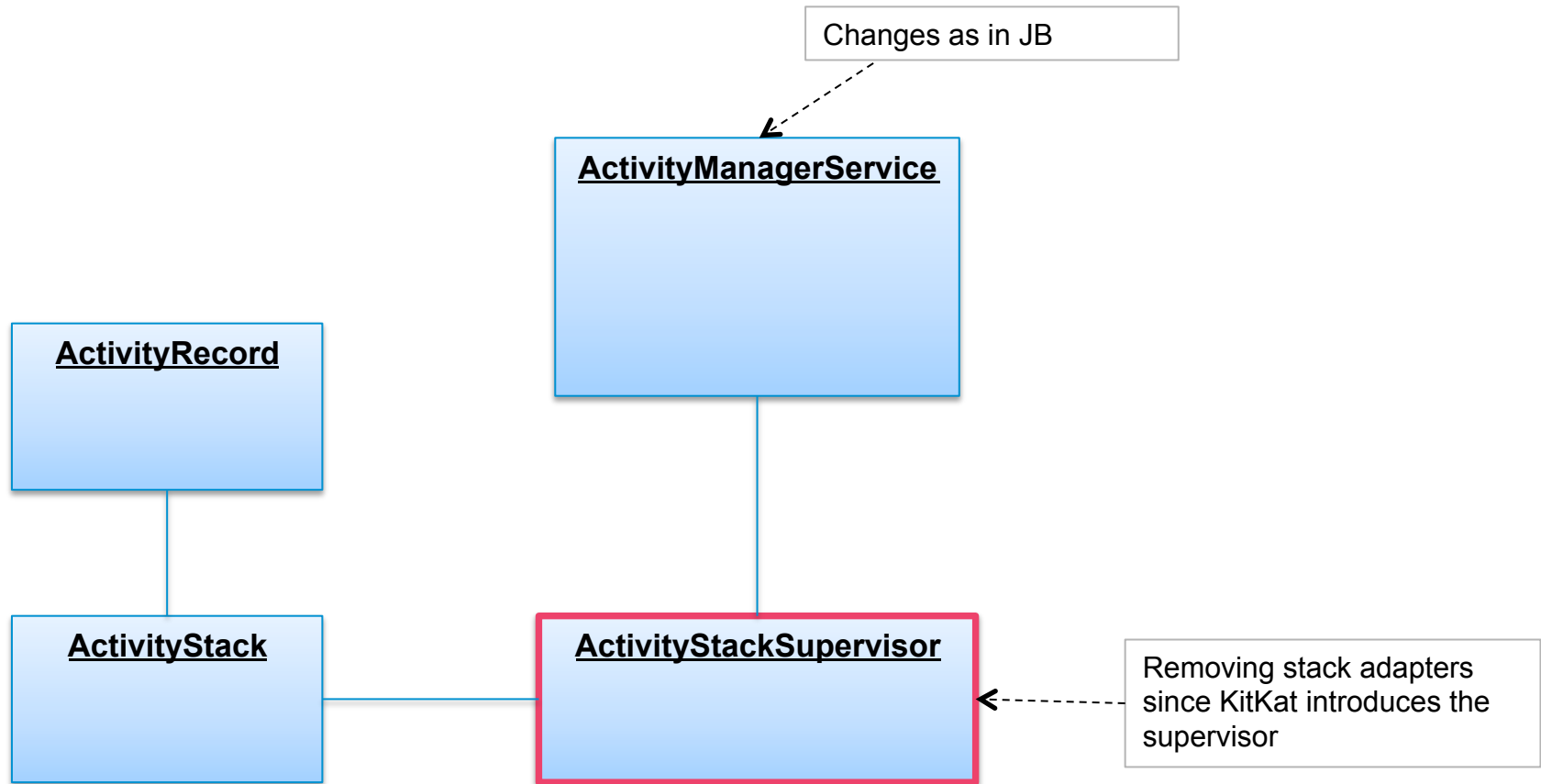
```
int initWindow(Rect position) - creates new stack and window  
void relayoutWindow(int stackId, Rect position) - changes position  
void removeWindow(int stackId) remove window from a screen
```



Added 2 classes introducing multiple activity stacks

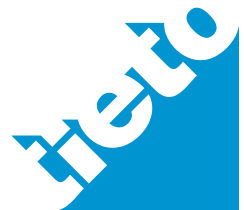
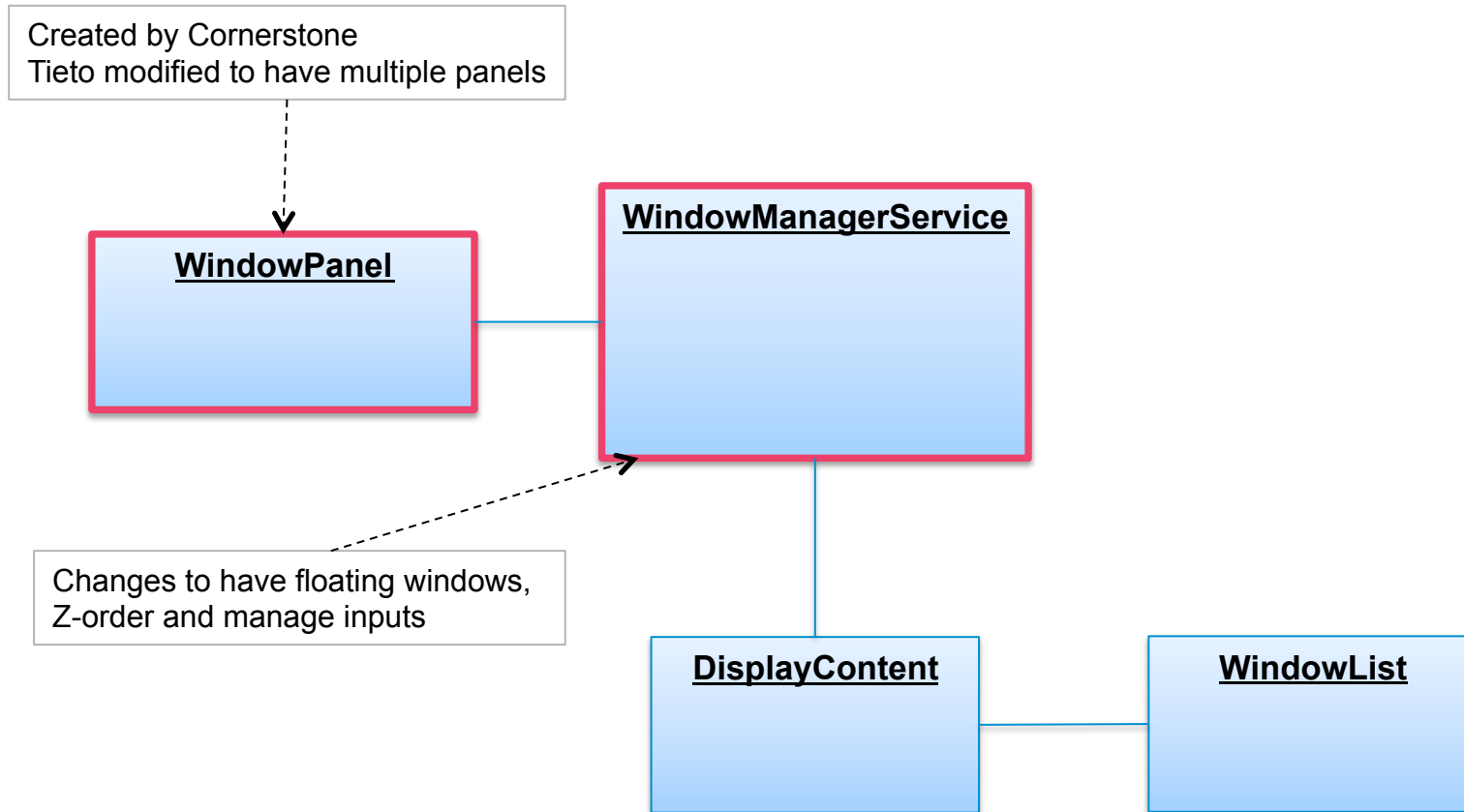
ActivityManagerService changes

KitKat



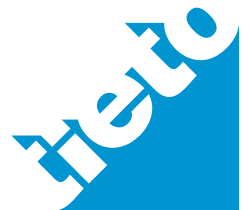
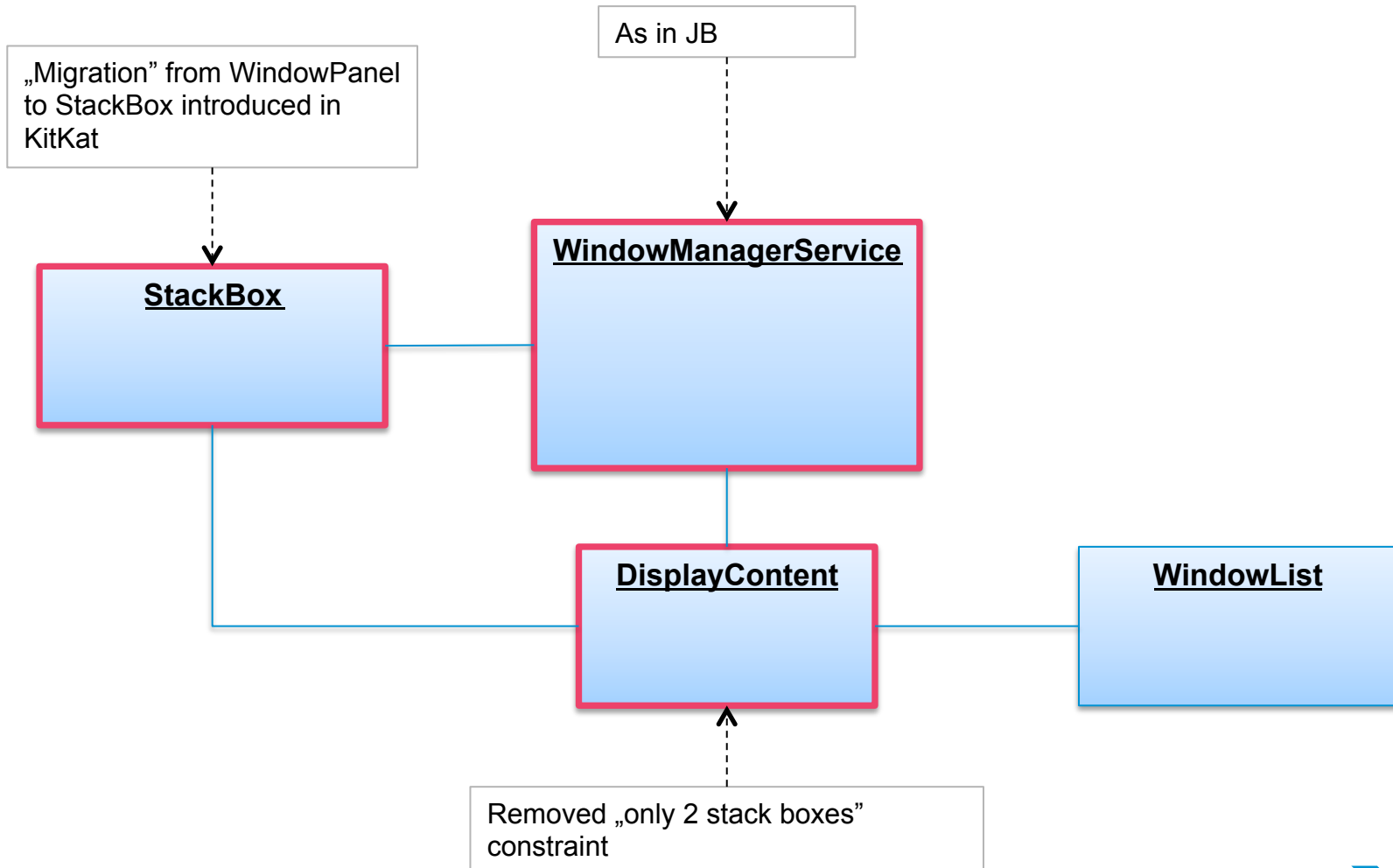
WindowManagerService changes

Jelly Bean (4.2)



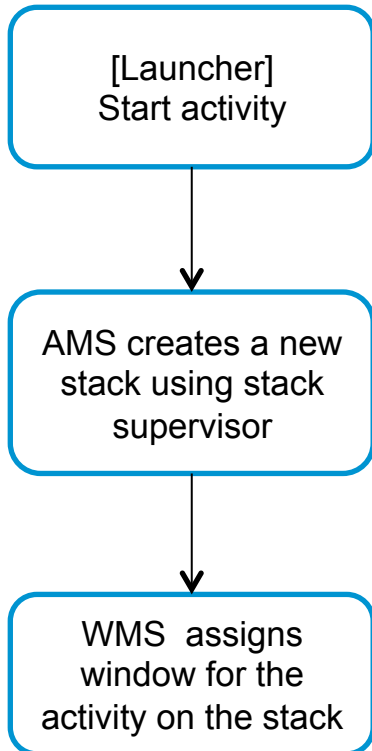
WindowManagerService changes

KitKat



Use cases

New activity, KitKat



Launcher

```
intent.addFlags(Intent.FLAG_ACTIVITY_NEW_TASK |  
Intent.FLAG_ACTIVITY_RUN_IN_WINDOW);  
startActivity(app.intent);
```

StackSupervisor

```
int stackId =  
mService.createStack(-1, parentStackId, isMultiwindow ?  
StackBox.TASK_FLOATING : StackBox.TASK_STACK_GOES_OVER, 1.0f);
```

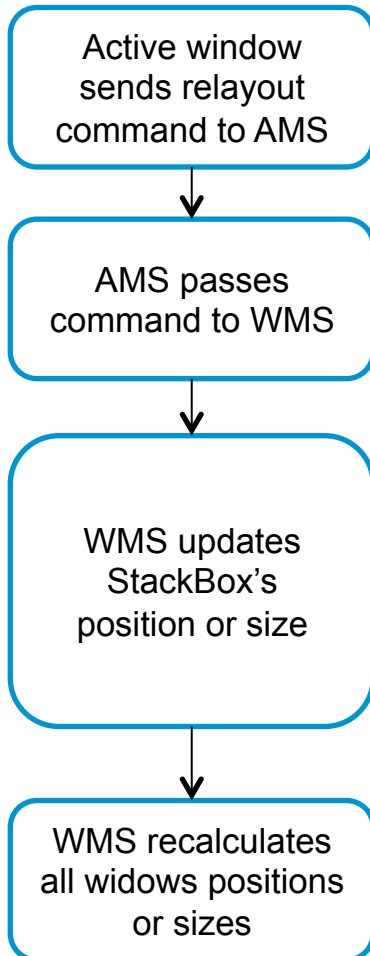
WindowManagerService

```
StackBox newBox = new StackBox(mService, this, position, null);
```



Use cases

Resize or move, KitKat



PhoneWindow

```
ActivityManagerNative.getDefault().relayoutWindow  
(getStackBoxId(), mNewFrame);
```

ActivityManagerService

```
mWindowManager.relayoutWindow(stackID, r);
```

WindowManagerService

```
for (StackBox sb : mStackBoxes) {  
    if ((sb.getStackId() == stackBoxId) &&  
        (sb.relayoutStackBox(pos))) {  
        layoutNeeded = true;  
        return true;  
    }  
}
```

WindowManagerService

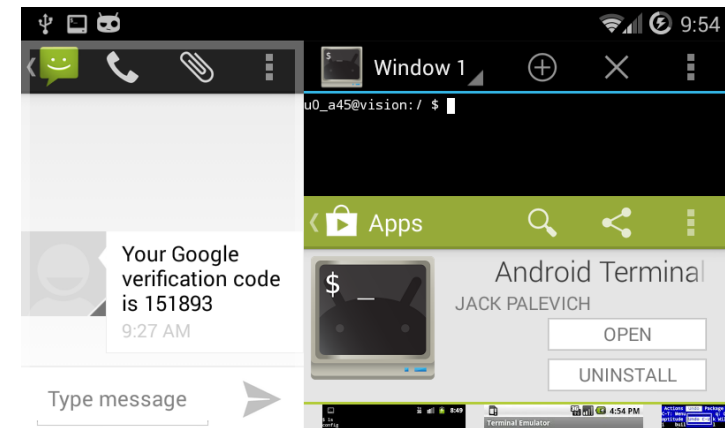
```
performLayoutAndPlaceSurfacesLocked()
```

Multiwindow support in KitKat



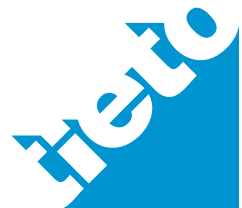
Status

- AOSP re-design work ongoing
- Visible today:
 - ActivityStackSupervisor
 - StackBoxes
 - Screen split functionality – early stage
 - Move windows, resize
 - New activity manager API (not public for apps)



```
adb shell> am stack boxes
...
adb shell> am stack create <task_id> <rel_stackbox_id> <position> <weight>
```

At this stage SDK level accesses to the classes would enable developers to create their own „multiwindow layout managers”

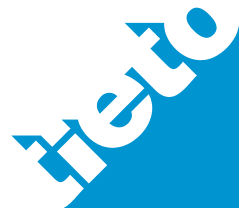
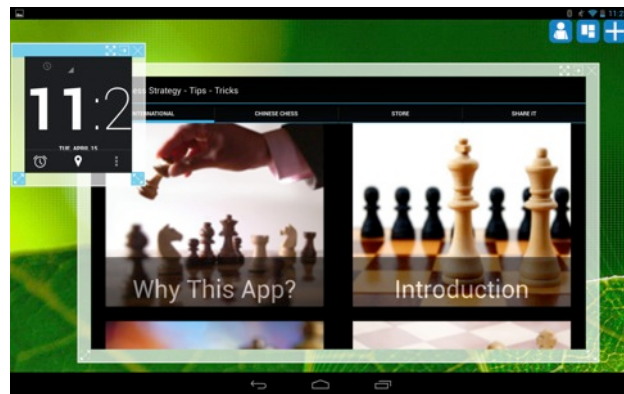


Lessons learned



User experience

- Reload config (layout resources) files when resizing? How often?
 - Yes → possible flickering
 - No → graphics not adjusted to a size
- Many apps don't look perfect when resized, duh!
 - No wonder Samsung has a whitelist
- Hard to get back when experiencing multiwindow 😊



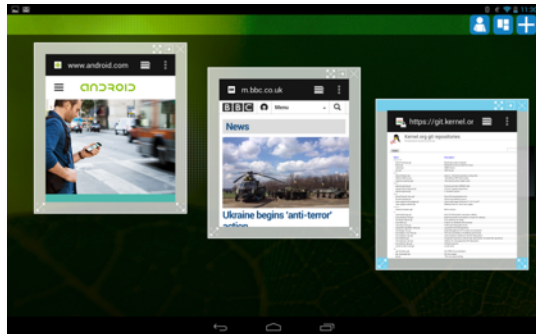


Lessons learned

Resources and performance

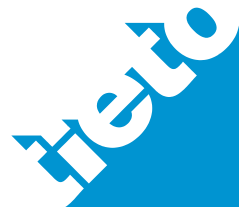
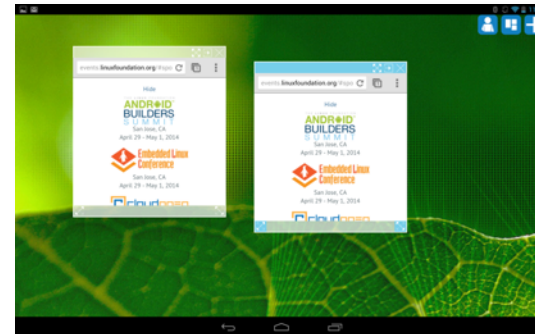
- Small performance penalty [1-3%]
 - About 20 apps running when OOM killer activates
 - CPUs don't break a sweat (Dual core, Quad Core, ARM & X86)
- Redrawing complex apps is slow, option is to show only borders when resizing
- Potential conflicts when accessing resources
- Multi-Instance behavior is different across applications

Browser



VS

Chrome

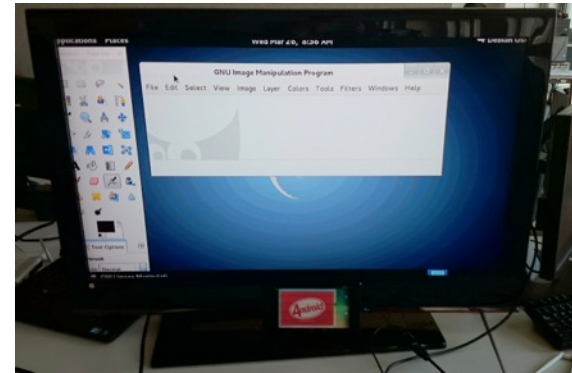


Lessons learned

New opportunities



Social TV
„Watch and chat”



Dual screen, dual OS
„Debian on Android”



Remote control
Using Multiwindow API



„Talk is cheap, show me the code”

- https://github.com/tieto/multiwindow_for_android/tree/tieto_multiwindow (4.2.2)
- https://github.com/tieto/multiwindow_for_android (4.4)
- All needed code as well instructions to build and run available
- Licenses:
 - [Apache 2.0](#) (frameworks, AOSP apps)
 - [GPLv3](#) (Tieto reference apps)

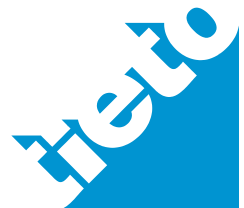




Git activity summary *

Package	Changes	Author
frameworks/base	39 files changed, 9443 insertions(+), 133 deletions(-)	Cornerstone
frameworks/base	51 files changed, 2587 insertions(+), 5369 deletions(-)	Tieto
packages/apps/ TietoLauncher	20 files changed, 947 insertions(+)	
packages/apps/ TietoMultiWindow	50 files changed, 2658 insertions(+)	
packages/apps/Launcher2	4 files changed, 30 insertions(+), 20 deletions(-)	
packages/apps/Settings	9 files changed, 344 insertions(+)	

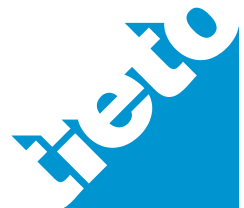
* Numbers for Jelly Bean
For KitKat approx. 1000 lines changed





Project FAQ

Questions	Answers
How to build & use it?	Instructions in readme and project wiki
Where is my ROM?	We don't provide ROMS, sorry. You can build your own 😊
Can I contribute?	Sure, pull requests welcomed.
How do I get support?	Create github "issues" in Multiwindow project. We'll do our best.
Will you support Device X?	The solution is HW agnostic (device, architecture). We test in a wide numbers of devices (nexus, Xperia, x86 bay trail, ..)
Is the solution CTS compliant?	Not at this time





What next?

- Follow up upstream 4.4 and next
- New Launcher
- Optimizations
- CTS compliancy
- Collaborate with you 😊



That was all folks, Thanks!

Questions ?

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